The Examiner objected to the title as being insufficiently descriptive. Applicants propose amending the title to read: PULSED MODE LYSIS METHOD. An indication that the amended title is acceptable is respectfully requested.

The Examiner objected to the specification on the grounds that at page 17, line 28, "FIG. 22" should be "FIG. 23". Applicants thank the Examiner for this helpful suggestion, in identifying a minor informality and have corrected page 17 as suggested.

Claims 26, 31, 33 and 37 were rejected under 35 U.S.C. § 112, second paragraph, for various reasons.

Claim 26 was rejected on the grounds that the operating frequency set forth was unclear. Applicants have amended claim 26 to clarify that the operating frequency is 20-100 KHz.

The Examiner rejected claim 31 on the grounds that "the peak power output" lacked proper antecedent basis. Applicants have amended claim 31 to clarify that ultrasound is produced with a transducer which is operated at a specified peak power output.

The Examiner rejected claims 33 and 34 on the grounds that the values for "T" were not clearly defined. Applicants have amended claims 33 and 34 to clarify that "T" refers to the pulse repetition period and $\leq$ 1,000 milliseconds.

Claim 37 was rejected on the grounds that it merely described structural limitations. Applicants have amended claim 37 to more positively describe the steps of inserting a guide catheter and inserting a transmission member in an unsheathed condition and transmitting ultrasound via the unsheathed transmission member.

Applicants respectfully submit that the rejections under 35 U.S.C. § 112 have been adequately addressed and respectfully request withdrawal thereof.

Prior to addressing the rejections based on the prior art, applicants take this opportunity to set forth the following brief remarks in connection with their invention, which is directed to a method of applying ultrasound to a location within a body using a pulse method. Applicants have developed methods for treating various conditions within the body, such as obstructed arteries and veins, by applying ultrasound at the location of the obstruction, initiating cavitation within the lumen and ablating the obstruction with the cavitation generated. Applicants discovered that certain pulsed modes of operation could achieve cavitation with significantly less power output and significantly less generation of heat by the transmission wire within the body. The figures show various critical design criteria, whereby adjusting the duration of the pulse of ultrasound or the period of time between pulses can lead to particularly enhanced cavitation generation with very little heat build-up.

Turning now to the rejections based on the prior art, claims 1, 2, 4, 19, 21, 33, 34 and 37 were rejected as anticipated by Jones, U.S. Patent No. 3,941,122. The Examiner contends that Jones describes an ultrasound producing device having a pulse duration of about 1 microsecond and a pulse repetition period of less than 1,000 milliseconds. Applicants respectfully traverse this rejection.

Jones is directed to a high frequency ultrasound device for treating ophthalmic conditions. Jones appears to describe placing the tip of an ultrasound probe about 1-2 millimeters from the surface of the eye and applying ultrasound at a duration of about 1 microsecond, with a repetition period of about 10 milliseconds (100 pulses per second). Nowhere does Jones describe causing cavitation within the body. Causing cavitation within an eye can lead to undesirable effects. Rather, Jones appears to describe a method in which the object to be broken up is vibrated as a result of the ultrasound application and dissolves. (Column 6, lines 17-28). Accordingly, because independent

claims 1 and 19 and new claim 42 all refer to causing cavitation within the body, applicants respectfully submit that the anticipation rejection over Jones should be withdrawn. Also, because Jones does appear to describe an invasive device, any claim calling for the insertion of an ultrasound probe within the body is not anticipated.

Claims 19 and 23 were rejected as anticipated by Chapelon, U.S. Patent No. 5,720,287. Applicants respectfully traverse this rejection.

Chapelon describes a combination imaging and therapy ultrasound probe. Chapelon has been reviewed and no reference to operating the probe under proper power, frequency and pulsing conditions, such that cavitation is generated, have been found. Accordingly, applicants respectfully request withdrawal of the anticipation rejection over Chapelon.

Claims 20, 22-26 and 32 were rejected as obvious over Jones in view of Guess, U.S. Patent No. 5,069,664. The Examiner contends that Jones describes an ultrasonic treatment device that is placed "within" the body and that Jones produces ultrasound with a pulse duration of less than 100 milliseconds and a pulse repetition period of less than 1,000 milliseconds. The Examiner contends that Guess describes operating the device at the frequency range of 20-40 KHz and that it would have been obvious to modify the Jones frequency to operate in the range of 20-40 KHz. The Examiner also considers the specific pulse duration and pulse repetition rates of claims 22-25 to have been obvious design choices. Applicants respectfully traverse this rejection.

Initially, Applicants note that Jones describes a device intended to be used externally from the body. (See column 7, line 64 through column 8, line 18). Also, Jones is specifically directed to a device in which frequencies on the order of 40 kHz and below are ***not*** used. Jones teaches a device in which the wave emitted from the tip of the probe

attenuates over a relatively short distance. Jones notes that if a 40 kHz acoustic energy is used, the wave would propagate over 10 meters, before it would be safe and thus, such a device would be "impossible to use". (Column 5, lines 21-32). Guess teaches a device that is entirely different from that of Jones. The Guess device includes a single or double wire tip which comes in contact with the obstruction and vibrates against the obstruction with a jackhammer-like action to break it up (see column 1, lines 15-20 and column 3, lines 24-25 and FIG. 6). Thus, it would not be obvious to select a frequency used in a device which breaks up an obstruction with mechanical interaction, for use in a device in which ultrasound is transmitted non-invasively over a relatively short distance and causes an obstruction to dissolve from being vibrated by the ultrasound. Thus, one of ordinary skill in the art seeking to modify to the Jones device would look to other non-invasive-type devices or other devices in the ultra high frequency range, and not at a device such as Guess, in which a vibrating metal tip breaks up an obstruction in a jackhammer-like action. Accordingly, Applicants respectfully request that the rejection over Jones in view of Guess be withdrawn.

Applicants also note that the pulse duration and repetition values of the claims have significant and critical advantages, which are nowhere described in either Jones or Guess (or any other reference of record). For example, the figures show how varying the pulse repetition period or pulse duration can lead to optimizations of cavitation and lower (safer) power use and how probes in accordance with the invention can be operated within a body, without substantially increasing in temperature, as a result of the proper selection and relation between pulse duration and pulse repetition as well as power and frequency. Accordingly, withdrawal of the rejection over Jones in view of Guess is respectfully requested.

Claims 20 and 24 were rejected as obvious over Chapelon in view of Guess. The Examiner considers Chapelon to describe an ultrasound treatment device that is placed within the body and which operates at a pulse duration of about 50 milliseconds and at high frequency. The Examiner considers it obvious to use the Guess frequency in the Chapelon device. Applicants respectfully traverse this rejection.

Applicants respectfully submit that neither Chapelon nor Guess describe an invasive method in which the probe is operated at sufficient power, frequency and pulsing conditions, so as to induce cavitation within the body. Cavitation is simply not mentioned. Rather, both references describe a device that presses against and mechanically agitates the tissue to be treated. Chapelon teaches directing ultrasound into the tissue for therapeutic purposes, but in no way teaches or suggests creating cavitation. (See col. 12, line 26, to col. 13, line 10.) Furthermore, neither reference describes how adjusting the pulsing parameters can lead to cavitation at reduced power and without substantial increases in probe temperature. Accordingly, applicants respectfully request withdrawal of the rejections.

Claims 27 and 30 were rejected as obvious over Chapelon or Jones in view of Balamuth. The Examiner considers Balamuth to describe an ultrasonic method in which the output power of the probe is 15 watts. Applicants respectfully traverse this rejection.

With respect to the combination of Jones and Balamuth it would not have been obvious to modify a probe used for external applications of ultrasound to the eye, by looking to operating conditions of Balamuth, which are intended to provide a method of ultrasonic cauterization, in a device such as an ultrasonic scalpel. The operation of an ultrasound device depends not only on power, but also on frequency and pulsing conditions (if any). Jones specifically teaches to avoid ultrasound operating conditions of

devices such as Balamuth. For example, Jones teaches to avoid increases in temperature, whereas cauterization involves joining tissues through the use of heat. (Column 2, lines 45-62). Thus, one seeking to modify the operation of the Jones device would not look to a Balamuth device, because of the undesirable increase in heat which is to be avoided if Jones is followed.

Similarly, one seeking to modify the Chapelon device would not look to operating conditions from Balamuth, because Chapelon does not seek to generate the heat needed to cauterize a wound. Also, the conditions for vibrating a scalpel are not what one in the art would look to when seeking to apply therapeutic ultrasound to tissue. Furthermore, neither reference describes operating under conditions so as to promote the formation of cavitation and neither of the references describes adjusting pulsing conditions to achieve cavitation at significantly reduced energy output and heat build-up. Accordingly, Applicants respectfully request withdrawal of the rejection.

Claims 28, 29 and 31 were rejected as obvious over Jones as applied to Guess and further in view of Balamuth. Again, applicants respectfully submit that one would not look to operating conditions from a device used to generate sufficient heat to cauterize a wound, in a device intended to achieve Jones' objectives. Accordingly, withdrawal of the rejection is respectfully requested.

Applicants have added new claim 42 which corresponds to allowable claim 18 and have added new dependent claims 43-52, which correspond to dependent claims already pending in the application. Accordingly, allowance of claims 42-52 is respectfully requested.

Applicants respectfully submit that each of the objections and rejections has been addressed and withdrawal thereof to place the application in condition for immediate allowance is respectfully requested. In the event the Examiner is not in a position to issue

an immediate Notice of Allowance, the Examiner is respectfully requested to telephone applicant's attorneys with a view towards resolving any outstanding issues.

Early and favorable action is respectfully requested.

Respectfully submitted,

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